

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Friedrich BOECKING et al.  
Based on : PCT/DE 03/03366  
For : PIEZOELECTRIC ACTUATOR  
Docket No. : R.304047  
Customer No. : 02119

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Date: June 15, 2005

**INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR 1.97(b),  
AND EXPLANATION OF THE RELEVANCE OF THE CITED PRIOR ART**

Sir:

The undersigned hereby requests that the prior art cited on the attached prior art statement be placed of record in the application file and be considered by the examiner.

This citation of prior art is made under 37 CFR 1.97(b), since it is being filed within three months of the filing date and before the mailing of a first Office action.

The relevance of the prior art cited on the attached form PTO/SB/08a is as follows:

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**US 5,252,883**

This patent teaches a laminated type piezoelectric actuator having a laminated body formed by alternately laminating piezoelectric ceramic layers and internal electrode layers, each of which are approximately the same shape. The four corners or edges of each layer of the ceramic layers and the internal electrode layers, which edges extend in parallel with the lamination direction of the laminated body, are machined to form a convex, arcuate shape or an angled, planar shape. This enables the end parts of each layer, which have a high distribution density of microcracks, to be removed, so that interlayer short-circuiting between the internal electrode films caused by the microcracks is prevented. Accordingly, the operation life and the reliability of the actuator of this invention is extended and improved, respectively, even when it is driven by a driving voltage which is exactly or close to that of a dc voltage in a highly humid environment. By using a Pb (Ni<sub>1/3</sub>Nb<sub>2/3</sub>) O<sub>3</sub>-PbTiO<sub>3</sub>-PbZrO<sub>3</sub> system perovskite structure compound oxide as the piezoelectric ceramic piece, and removing each of the four edges in the cross section to exhibit a convex, arcuate shape with a radius of curvature equal to or greater than 1.0 mm, or an angled, planar shape having a chamfering length equal to or greater than 0.8 mm, it is possible to increase the life of the actuator to about 10 times that of the actuator in the prior art.

**US 2002/0153431 A1**

This published patent application teaches a piezoelectric element and an injector using the same piezoelectric element. The element and injector are constructed so as not to be shorted in a high humidity environment. They are small in size, low in cost, and high in heat

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radiation capability. The piezoelectric element comprises a ceramic laminate (10) including a plurality of ceramic layers of a piezoelectric ceramic (11) and a plurality of internal electrode layers (21, 22), stacked alternately. At least an organic insulating layer (41) of an organic material is formed on at least a part of the surface of the ceramic laminate (10), and at least an inorganic insulating layer (42) of an inorganic material is formed on the organic insulating layer (41).

**US 2002/0152857 A1**

This published patent application teaches a high reliability ceramic laminate which suppresses de-lamination and cracks. Wide ceramic sheets are temporarily laminated by heat and pressure to form a pre-laminate which is cut to form a unit body. Unit bodies are laminated to obtain a ceramic laminate. De-waxing removes not less than 90% of a binder resin before the ceramic laminate is sintered.

**WO 03/010835 A2**

This patent publication teaches a multi-layer PZT which comprises a plurality of stacked ceramic layers. The stack of ceramic layers includes a top ceramic layer on which negative and positive contacts for electrically coupling the PZT to external circuitry are formed. The stack of ceramic layers also includes at least one negatively poled ceramic layer having a negative conductive pattern formed thereon and at least one positively poled ceramic layer having a positive conductive pattern formed thereon. The PZT also includes a negative pattern interconnect for electrically connecting the negative contact and the negative conductive pattern and a positive pattern interconnect for electrically connecting the positive

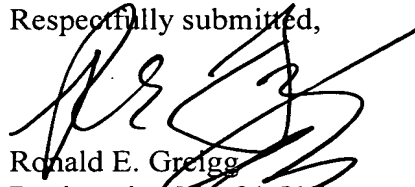
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contact and the positive conductive pattern. The multi-layer PZT can be fabricated using a ceramic co-firing process.

Examination of this application is respectfully requested.

Respectfully submitted,



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**Complete if Known**

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Attorney Docket Num

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Date	
Considered	

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

***If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.***